GSFC Engineering Colloquium

Using the Spacecraft Supermarket: Results & Lessons Learned

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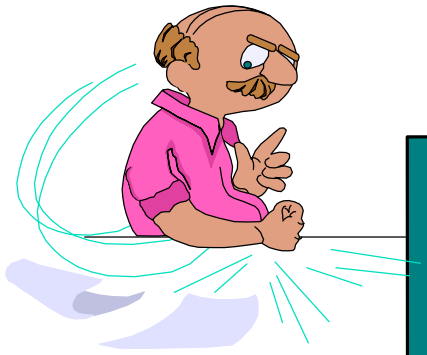
http://rsdo.gsfc.nasa.gov

Program Themes

- **Contract for What Industry has to Offer**
- **Fixed Price Orders With Necessary Insight**
- **Milestone Completion Based Payments**
- **Allow Mission Unique Modifications to Basic Offerings**
- **Fair Opportunity to be Considered in Rapid Selection Delivery Order Process**
- **Volume of Orders Needed to Maintain Interest**
- **No Protests Allowed by FAR 16.505 (a)(7)**

The Players



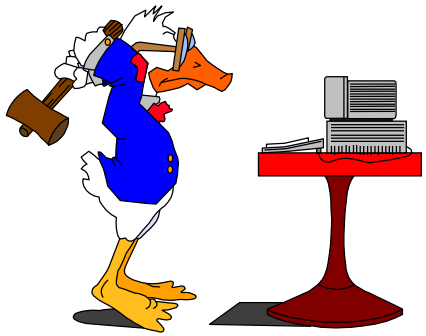
Project Management

Vendors

Rapid Spacecraft Development Office

Program Management

Contracts & Legal



“Multiple Award” IDIQ Contracts

- **Authorized by the Federal Acquisition Streamlining Act of 1994 (FASA) Section 1054, P.L. 103-355, 42 U.S.C. 253h**
- **A *Preference* for the Award of *Multiple* Indefinite Quantity Indefinite Delivery (IDIQ) Contracts to Two or More Sources**
  - Ensures qualified Vendor pool
  - Shortens Procurement Lead Time
  - Reduces Procurement Resources Expended
  - Continual Competitive Environment Affects:
    - Prices
    - Innovation
    - Performance

Rapid Spacecraft Acquisition

- Rapid Spacecraft Development Office (RSDO)
  - Flight Programs and Projects Directorate
- Rapid I Contracts: October 1997 - October 2000
  - Awarded 5 spacecraft delivery orders
  - Numerous accommodation studies
- Rapid II Contracts: January 2000 - December 2004
  - Raises the “bar” for core bus selection
- Quickride: Open contract for payload space

Rapid II

- Multiple Award IDIQ Contracts
  - 15 Core Busses
  - 6 Vendors with Proven Track Records
- Contracts Open to Any US Government Agent
  - Other NASA Centers
  - USAF, NAVY, DOE, DARPA, etc. (1.5% Fee NTE $150K)
- Institutions With NASA Sponsorship - e.g. PI mode
- Spacecraft Delivery Orders can be Placed in 30 to 90 Days Depending on Customer Requirements

RAPID II
Core Busses & Success Stories

BALL

BCP 2000 (QUIKSCAT)

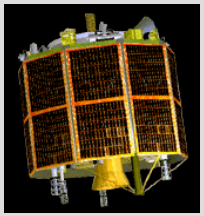
ICESAT
QUIKSCAT

BCP600 (GFO)

LOCKHEED

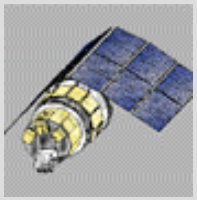
LM900 (IKONOS)

SURREY

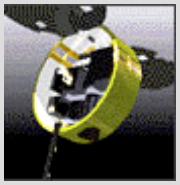


MINISAT 400 (VOSAT12)

ORBITAL

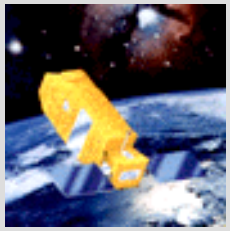


LeoStar (STEP 0)

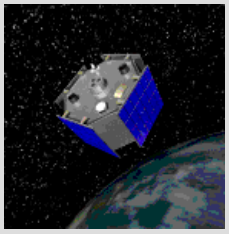


MicroStar (BATSAT)

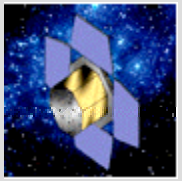
QUIKTOMS



MidStar (FUSE)



Ministar (ACRIMSAT)



PicoStar (MIGHTYSAT 1)

StarBus (INDOSTAR)

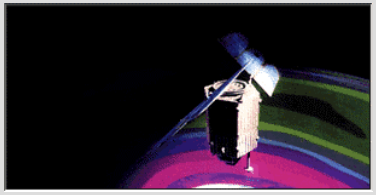
SPECTRUM ASTRO

SA200HP (D51)

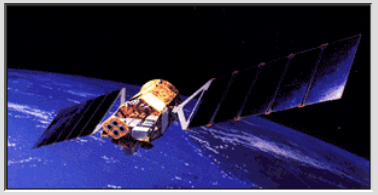
CORIOLIS
SWIFT

SA200S (MST1)

TRW



T100 (TOMS EP)



T200A (ROCSAT)

T200B (LEWIS)

Contract Scope

- Mini-Competitions Effecting Offer Updates for Specific Missions - - Expect modification of core bus!
  - Spacecraft buy
  - Accommodation Assessments
  - Technology Infusion Studies (eg S/C Internet Protocol)
- “Fair opportunity to be considered”
- Right to “Sole Source” (Limited by GSFC Policy)
- Full Mission Payload & Spacecraft Integration Activity
- Launch Site integration support

Contract Scope - Continued

- Delivery On-orbit
  - After 30 day checkout,
  - Final payment, typically 10%
- Optional Services
  - Mission operations
  - Launch services - with Code M concurrance
- Ability to buy subsystem commercial components at market price
- Annual Baseline Updates for Performance Changes
- Semi-Annual On-Ramp of new buses and vendors

On Ramps and Technology Updates

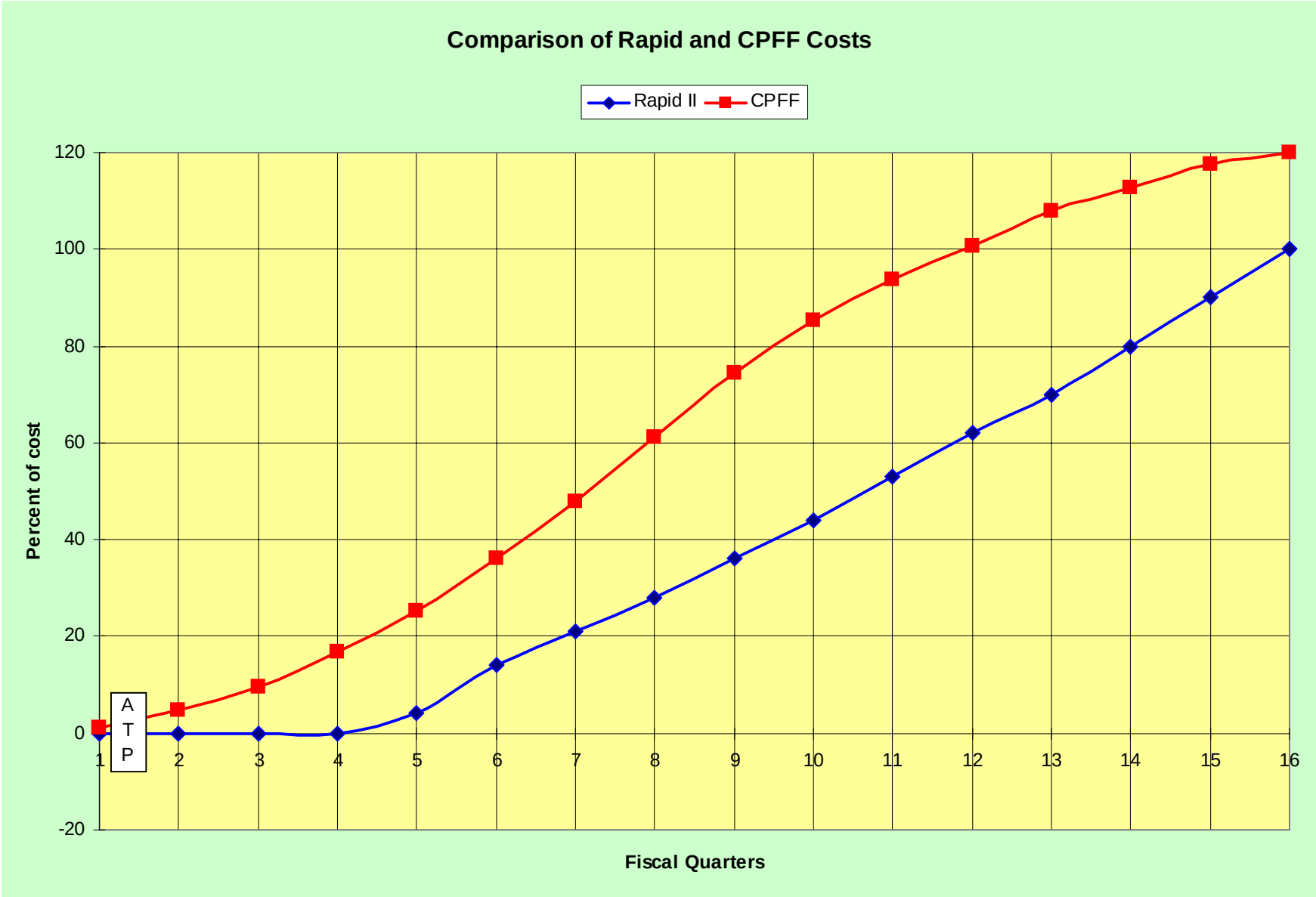
- "On Ramps" allow for new capabilities on the contracts
  - New Vendors and New Busses eligible at each On Ramp
  - On Ramps Open every February and August for Rapid II
  - QuickRide On Ramp always open
- Core Busses may upgrade technology annually or in response to RFO
  - Parts obsolescence
  - S/C architecture remains unchanged
- Rapid II - Fall 2000 On-Ramp was heavily used
  - Received proposals for 8 core buses from 6 vendors
  - Several new offerors, some old offerors with new busses.

Results

- Eliminates the Need for Source Evaluation Boards
  - Customer buying team with RSDO facilitation
- Reduced Procurement Lead-Time from

  9 - 12 Months to 30 - 90 Days
  - ***Request for Offer***: SOW, CDRL, Performance Spec, Implementation Requirements
  - ***Vendor Proposal***: mark-up of model contract
  - Selection Briefing Package: S/C SSO is Director of Code 400
  - ***Delivery Order*** transfers to Customer's Contracting Officer
- Saved up to $20M Per Mission

Cost Profiles - CPAF vs. FFP



Results - continued

- Shortens Delivery Time (QuikSCAT 11 months)
- A Vehicle for Scientists to Team with an Industry Partner for Announcement of Opportunity (AO) Competition
- Delivery Order may be made contingent upon AO competition selection
- Trend towards iterative accommodation studies
  - Requirements/Cost trades

AO Fit

	Ball RS2000		LM-100		LM-900		OSC Starbus		LS-400		SA 200HP	
Instrument Mass (kg)	<=340	80%	<=24	11%	<=500	86%	<=200	70%	<=350	80%	<=300	77%
Lifetime (m)	<=60	99%	<=36	93%	<=72	99%	<=120	100%	<=90	100%	<=60	99%
Pointing Knowledge (arcsec)	>=3	80%	>=3600	9%	>=10	75%	>=108	45%	>=3.6	75%	>=1	95%
Pointing Control (arcsec)	>=103	67%	>=7200	21%	>=12	88%	>=144	67%	>=72	67%	>=20	88%
EOL Power (W)	N/D		<=200	52%	<=1082	91%	N/D		<=1300	94%	<=3000	100%
Data Downlink Rate (Mbps)	<=320	100%	<=0.0036	4%	<=320	100%	<=50	96%	<=3	68%	<=10	88%
On-Board Data Storage (GB)	<=25	93%	<=0	3%	<=10	88%	N/D		<=1.25	63%	<=7.5	87%

	SA 200LL		SSTL Microsat		Swales Rapid		TRW SSTI 750		TRW STEP-E XC		Spartan 400	
Instrument Mass (kg)	<=500	86%	<=35	17%	<=200	70%	<=1000	97%	<=318	79%	<=907	97%
Lifetime (m)	<=60	99%	<=36	93%	<=18	32%	<=72	99%	<=60	99%	<=12	24%
Pointing Knowledge (arcsec)	>=1	95%	>=18000	2%	>=20	69%	>=10	75%	>=36	58%	N/D	
Pointing Control (arcsec)	>=20	88%	>=18000	7%	>=23	88%	>=108	67%	>=108	67%	>=60	81%
EOL Power (W)	<=1500	97%	<=22	2%	<=300	56%	<=750	88%	<=250	56%	<=640	86%
Data Downlink Rate (Mbps)	<=20	90%	N/D		<=4	84%	<=150	99%	<=45	94%	<=2	59%
On-Board Data Storage (GB)	<=7.5	87%	N/D		N/D		<=12	88%	<=8	87%	N/D	

90-100%
70-89%
50-69%
<50%
N/D No Data

Recently a study was conducted by the Office of Space Science to compare the capabilities of RSDO catalog buses (Rapid I), as well as Spartan, with the collected mission requirements of MIDEX (35 in 1998) and SMEX (52 in 1997) applicants. For each bus and parameter, the percentage of SMEX and MIDEX missions which could be satisfied by that bus was calculated.

Studies Performed

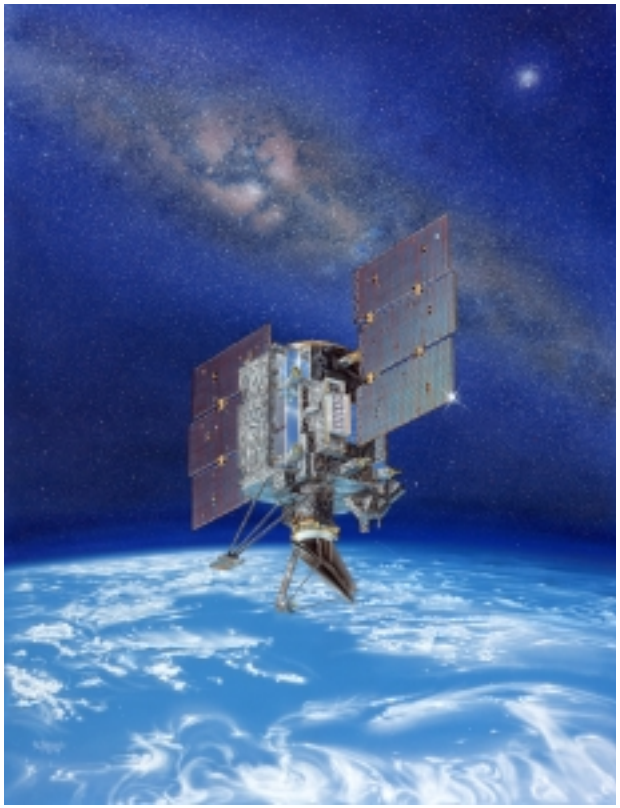
Rapid I Studies

- Solstice (3 Vendors)
- POES C&DH (2)
- Swift Phase A (1)
- (4 other MIDEX CDOs - 1 each)
- Coriolis (3)
- PicoSat Study (1)

Rapid II Studies (to date)

- MMS #1 (4 Vendors)
- GLAST 2000 (3)
- NPP#1 (5)
- IP Study (4)
- LRR (4)
- *MMS #2 in FY01*
- *NPP Phase B in FY01*

QuikSCAT



- SeaWinds instrument measures near-surface wind speed and direction under all weather and cloud conditions over Earth's oceans
- ”Quick recovery" mission to fill the gap created by the loss of data from the NASA Scatterometer (NSCAT) due to ADEOS S/C failure

QuikSCAT - Ball

- Extremely important for customer to develop good working relationship with contractor, form Integrated product team
  - NASA viewed as extra set of eyes, value added
  - Development not error free, allow contractor time & offer assistance when needed.
- Monthly management & splinter meetings
  - Followed BATC standard process
  - Excellent insight & enhanced resolutions
- IDIQ structure & BATC's excellent cooperation allowed contract modifications to be worked expeditiously

QuikSCAT Lessons Learned & Risk Management

From 15th Annual GCA Quality Symposium

Pre-contract

- Understand/challenge requirements
- Instrument needs to be well characterized & interfaces identified
- Strive for large S/C margins & redundancy if possible
- Make S/C contractor responsible for mission ops. & select L/V

Implementation

- BE A GOOD CUSTOMER
- TEAMWORK between all organizations is a must
- Work/stick with requirements/interfaces early
- Better is the enemy of good enough
- Determine mission criticality of risks, develop options & work arounds; but minimize/reduce trades early
- Peer reviews extremely effective, follow contractor STD process

ICEsat

- GLAS is a laser altimeter with 1 Meter diameter telescope designed to measure ice-sheet topography

ICESat - Ball

- Three year effort
  - 1st year used for interface definition for evolving instrument
    "Special Studies" at preset rates for risk mitigation and to scope changes
  - 2 years for fabrication and test
- Significant modifications to Delivery Order
  - Implement interface changes
  - Change launch vehicle from Athena to Delta
  - Add MOC/FOT operations
- Lessons Learned
  - Use instrument and spacecraft simulators to debug interface
  - Use "as-is" documentation wherever possible
  - Fixed-price change orders are similar to cost-plus, a viable path
  - Minimize government furnished equipment (GFE) - false savings

QuikTOMS

- Total Ozone Mapping Spectrometer Flight Model 5 (TOMS-5) maps the global distribution of the Earth's total column of the atmospheric ozone

QuikTOMS - Orbital

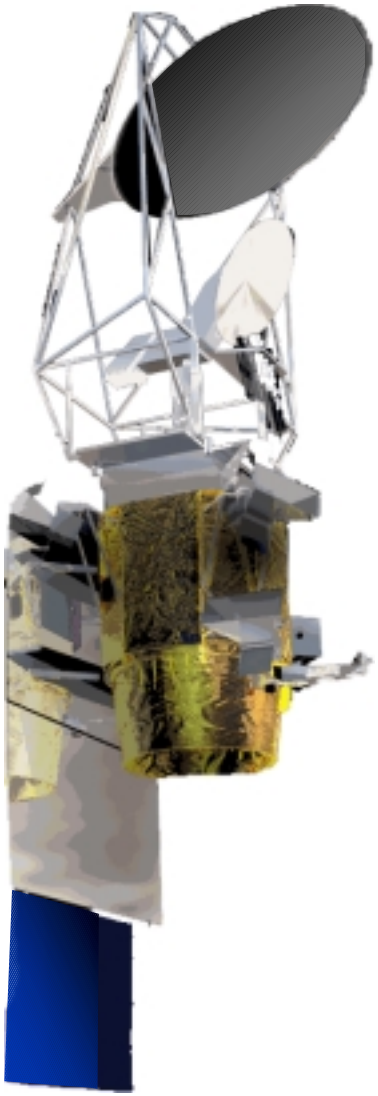
- Schedule is stretching, due to launch vehicle availability
- Excellent insight and access to documentation
- Contractor very cooperative; but NASA suggestions related to issues and problems & Contractor response cycle too long
- Contractor scheduling techniques and internal communications needs improvement

Swift

- BAT is a wide field of view gamma ray imager that will produce arc-minute burst positions onboard within 10 seconds and cause Swift to autonomously slew in 50 seconds. GSFC in-house; new design
- XRT: X-ray telescope. Penn State, Univ. of Leicester(UK) & Brera Univ. (Italy)
- UV/OT: Ultra Violet and Optical Telescopes. OM from XMM(Mullard Space Sci. Lab-UK), Penn State

Swift - Spectrum Astro

- The SWIFT payload is a conglomerate of instruments
  - BAT, XRT, UV&OT
- Challenges:
  - Mass Margins large going in - consumed by instruments
  - ITAR: S/C - XRT, UV& OT thermal, mechanical interface design info
- Mitigation of Risk: Instrument maturity, S/C structure
  - Development Test Vehicle - sequential qual structural program
  - Instrument bench - Allows for a de-coupled & parallel development
- Spectrum Astro has been very cooperative with NASA



Coriolis

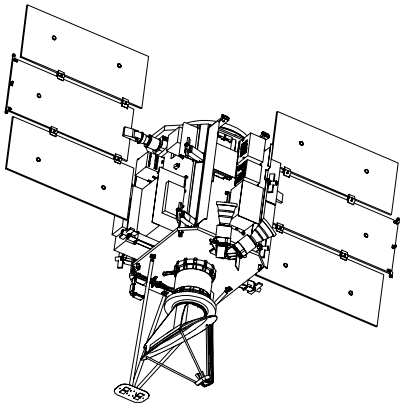
- Windsat (NRL)will passively measure ocean surface wind vector
- Solar Mass Ejection Imager (SMEI) AFRL observes solar activity and solar mass ejections in visible light to predicting geomagnetic disturbances to orbiting satellites

Coriolis - Spectrum Astro

- Managed by the Space Test Program (STP), at Kirkland AFB, Albuquerque, NM.
- One modification to improve mass margins, STP felt that vendor price was reasonable
- Vendor questions on surety/liability/indemnity on Coriolis (CLSA, FAR, DFARS,PL)
- STP would like SA support beyond L+30. Their preference may be to do a separate delivery order for Ops services/advice
- Generally pleased with the progress in the Coriolis mission and in Spectrum Astro's performance

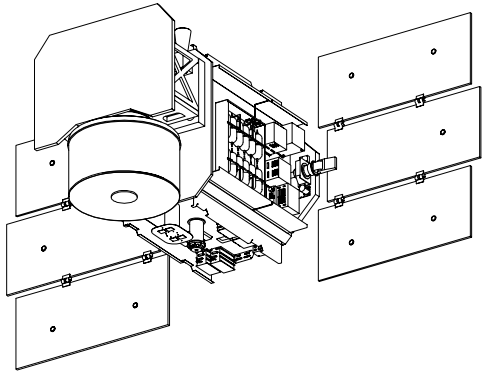
Success Stories

QuikSCAT



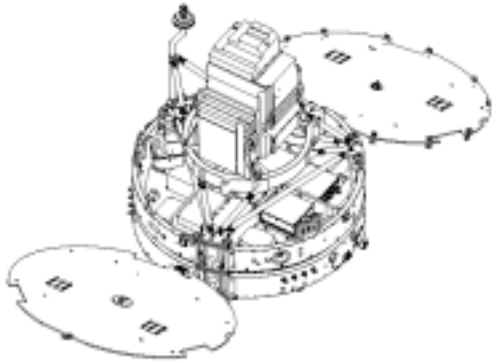
- Acquisition took 3 Weeks
- $39M Includes 2 Years Operations
- 12 Months to Launch ARO
- Launched June 19, 1999
- Mission not Possible without RSA

ICESat



- Acquisition took 90 Days
- $39M is 35% Less than Previously Estimated
- ARO to Launch in 32 months
- Saved $20M & 1 Year

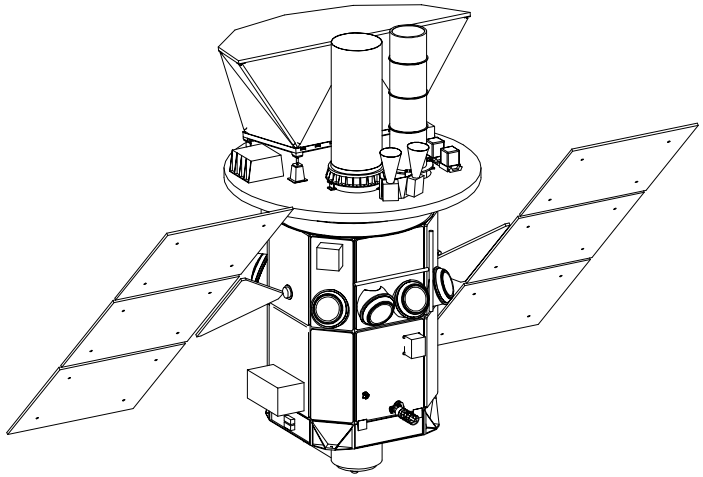
QuikTOMS



- Acquisition took 5 Weeks
- $15M Includes 3 Years Operations & Ground Systems
- ARO to Launch in 13 months

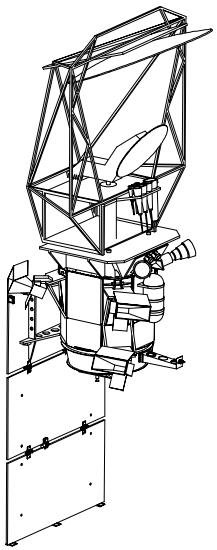
Success Stories - Continued

Swift



- Acquisition (original Study) took 5 weeks
- $36M
- Contingent Delivery Orders used
- ARO to Launch in 36 months
- First Staged Acquisition for support of MIDEX AO

Coriolis



- Acquisition took 60 Days
- $36M
- First USAF use of RSDO
- ARO to Launch in 30 months
- Groundbreaking Inter-Agency Pathfinder

RSDO Resources

- Have Data
  - From Rapid II Contracts
  - From Spacecraft and Study Competitions
- Have Personnel familiar with data and limitations
- Have RSDO Pricing Model
  - Based on Contracts and Competitions
  - Significant User Knowledge Required
- Will assist as long as data and Proprietary concerns can be protected
- Additional Information at: http://rsdo.gsfc.nasa.gov